

What is claimed is:

1. A cellular structural lightweight concrete comprising, by weight:

- a) about 30% to about 45% cementing material;
- 5 b) about 20% to about 55% aggregate;
- c) about 0.02% to 5% fiber;
- d) a lime containing material;
- e) a shrinkage reducing agent;
- f) about 0.001% to 1.0% of a gas-forming agent or
- 10 a foaming agent; and,
- g) about 12% to 30% water.

2. The concrete of claim 1 having a dry density from about 45 lb/ft³ to about 90 lb/ft³.

15 3. The concrete of claim 1 wherein a compressive strength of the concrete is from about 1,000 psi to about 6,000 psi after 28 days of curing at room temperature.

20 4. The concrete of claim 1 wherein the cementing material includes Portland cement.

25 5. The concrete of claim 1 wherein the cementing material has either cementitious or pozzolanic properties and is selected from the group consisting of coal fly ash, natural pozzolan, ground blast furnace slag, ground steel slag, silica fume, and mixtures thereof.

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6. The concrete of claim 1 wherein the aggregate is selected from the group consisting of volcanic ash, pumice, scoria, tuff, and expanded, palletized or sintered blast furnace slag, clay, diatomite, fly ash, shale, perlite, vermiculite, slate, and mixtures thereof.

7. The concrete of claim 1 wherein the aggregate includes both fine and coarse aggregate.

8. The concrete of claim 1 wherein the aggregate has a density between 25 lb/ft³ to 60 lb/ft³.

9. The concrete of claim 1 wherein the lime containing material is selected from the group consisting of quick lime, hydrated lime, and any material containing at least 50% free CaO.

10. The concrete of claim 1 wherein the shrinkage reducing agent is selected from the group consisting of at least one alkyl ether oxyalkylene adduct represented by the formula: $RO(AO)_nH$, wherein A is a C₂₋₄ alkylene radical, O is an oxygen atom, R is a tertiary alkyl group and n is an integer from 1 to 3, and an oxyalkylene glycol represented by the formula: $HO(AO)_mH$, wherein A is a C₂₋₄ alkylene radical, O is an oxygen atom, and m is an integer of 1 to 3.

11. The concrete of claim 1 wherein the shrinkage reducing agent comprises an alkyl ether oxyalkylene adduct and a tertiary alkyl group in a weight ratio of about 1:1.

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12. The concrete of claim 1 wherein the shrinkage reducing agent is present in a concentration about 0.01% to about 3%, by weight.

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13. The concrete of claim 1 wherein the gas-forming agent is selected from the group consisting of aluminum powder, zinc powder, magnesium powder, aluminum sulfate, and mixtures thereof.

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14. The concrete of claim 1 wherein the foaming agent is an alkaline salt selected from the group consisting of natural wood resins, fatty acids, sulfonated organic compounds, and mixtures thereof.

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15. The concrete of claim 1 further including fibers selected from the group consisting of nylon fibers, polypropylene fibers, carbon fibers, cellulose fibers, and mixtures thereof.

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16. The concrete of claim 15 wherein the fiber is present in a concentration of about 0.02% to about 5%, by weight.

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17. The concrete of claim 1 further comprising a superplasticizer as a linear polymer containing sulfonic acid groups attached to the polymer backbone at regular intervals.

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18. The concrete of claim 17 wherein the superplasticizer is selected from the group consisting of sulfonated melamine-formaldehyde condensates (SMF), sulfonated

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naphthalene-formaldehyde condensates (SNF), modified lignosulfonates (MLS), polycarboxylate derivatives, and mixtures thereof.

5 19. The concrete of claim 17 wherein the superplastizer is present in a concentration of about 0.02% to about 1%, by weight.

10 20. A method for making cellular concrete product using a cellular concrete mixture, comprising the steps of:

15 a) mixing, by weight, about 30% to about 45% cementing material with about 20% to about 55% aggregate, a lime containing material, about 0.02% to 5% fiber, about 0.01% to about 3% of a shrinkage reducing agent, about 0.001% to 1.0% of a gas-forming agent or foaming agent, and about 12% to 30% water to provide a concrete mixture;

b) pouring the concrete mixture to partially fill the total volume of a form;

20 c) allowing the poured concrete mixture to expand to the total volume of the form;

d) allowing the expanded concrete to set;

e) curing the set concrete in a moist environment; and

25 f) utilizing the cured concrete.

21. The method of claim 20 including providing the concrete having a dry density from about 45 lb/ft³ to about 90 lb/ft³.

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22. The method of claim 20 including providing the concrete having a compressive strength of from about 1,000 psi to about 6,000 psi after about 28 days of curing at room temperature.

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23. The method of claim 20 including providing the cement as Portland cement.

24. The method of claim 20 including providing the cementing material having either cementitious or pozzolanic properties and being selected from the group consisting of coal fly ash, natural pozzolan, ground blast furnace slag, ground steel slag, silica fume, and mixture thereof.

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25. The method of claim 20 including selecting the aggregate from the group consisting of pumice, scoria, tuff, and expanded blast furnace slag, palletized blast furnace slag, sintered blast furnace slag, clay, diatomite, fly ash, shale, perlite, vermiculate, slate, and mixtures thereof.

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26. The method of claim 20 including providing the lightweight aggregate as either fine or coarse aggregate.

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27. The method of claim 20 including providing the aggregate having a density of from about 25 lb/ft³ to about 60 lb/ft³.

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28. The method of claim 20 including selecting the lime containing material from the group consisting of quick

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lime, hydrated lime and any material containing at least 50% free CaO.

29. The method of claim 20 including selecting the
5 shrinkage reducing agent from the group consisting of at least one alkyl ether oxyalkylene adduct represented by the formula: $RO(AO)_nH$, wherein A is a C_{2-4} alkylene radical, O is an oxygen atom, R is a tertiary alkyl group and n is an integer from 1 to 3, and an
10 oxyalkylene glycol represented by the formula: $HO(AO)_mH$, wherein A is a C_{2-4} alkylene radical, O is an oxygen atom, and m is an integer of 1 to 3.

30. The method of claim 20 including providing the
15 shrinkage reducing agent in a concentration from about 0.01% to about 3%, by weight.

31. The method of claim 20 including selecting the gas
forming agent from the group consisting of aluminum
20 powder, zinc powder, magnesium powder, aluminum sulfate, and mixtures thereof.

32. The method of claim 20 including providing the
foaming agent as an alkali salt selected from the group
25 consisting of natural wood resins, fatty acids, sulfonated organic compounds, and mixtures thereof.

33. The method of claim 20 further including providing
the concrete comprising fibers selected from the group
30 consisting of nylon fibers, polypropylene fibers, carbon fibers, cellulose fibers, and mixtures thereof.

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34. The method of claim 33 including providing the fiber in a concentration of about 0.02% to about 5%, by weight.

5 35. The method of claim 20 further including mixing a superplasticizer of a linear polymer containing sulfonic acid groups attached to the polymer backbone at regular intervals.

10 36. The method of claim 35 including selecting the superplasticizer from the group consisting of sulfonated melamine-formaldehyde condensates (SMF), sulfonated naphthalene-formaldehyde condensates (SNF), modified
15 lignosulfonates (MLS), polycarboxylate derivatives, and mixtures thereof into the concrete mixture

37. The method of claim 35 including providing the superplasticizer in a concentration of about 0.02% to about 1%, by weight.

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